Space Weather Technical Forecast

Issued on Tuesday 12 November 2024 at 12:16 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1/R2 Likely throughout. Daily Slight Chance of G1 from midweek UTC.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured by GOES16 fell to Low over the past 24 hours, with occasional mid-ranking C-class flares observed, these largely emanating from AR3889 near centre-disc, with the peak event a C4.4 at 11/1428UTC.

There are currently six numbered sunspot regions on the disc, with AR3889 dominating in terms of complexity, with up to two Mount Wilson delta spots contributing to its overall Fki/Beta-Gamma-Delta classification. Most of the other regions formed a continuous train of spots in the southwestern quadrant, with apparently simplifying trends.

There were four main filament-related events noted in the period - firstly a large partial filament eruption in the south-central disc, peaking around 11/1600UTC. This event has been analysed and determined to pass below the ecliptic to no effect at Earth. Secondly, a large prominence eruption occurred on the northeastern solar horizon around 11/2100UTC. This too has been modelled and shown to be a miss (behind and above Earth's orbital track).

The two other events were an impulsive filament eruption in the far northwest at 11/2330UTC, and a slower emission in the far northeast at 12/0100UTC. These two final events have yet to be analysed but as a placeholder they appear largely directed limbward in both cases.

Pending full analyses, no Earth-directed CMEs were therefore in evidence.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE were indicative of a slow regime. The solar wind speed fell from highs of 425 to 375km/s, the solar wind density was generally within single figures ppcc and the IMF was small-scale and stable. Bt peaked at 6nT, with the north-south component varying between +/-5nT, with an erratic character. The phi angle was mainly positive (away from the Sun), but with occasional brief forays into negative.

The net result of the above solar wind measures was for Quiet geomagnetic activity throughout.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels.

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High energy electron flux (greater than 2MeV) observed by GOES16 was a Normal Background to Moderate levels, peaking at 338pfu at 11/1430UTC, with the daily peaks near similar values. The associated 24-hour fluence was well below the Active threshold, with 8.2e6 integrated flux observed at 12/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-class flares are Likely, with a Slight Chance of X-class flares, most likely from AR3889. No major changes in sunspot region populations are expected in the period, and the risk trend is level.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

One main coronal hole fast wind is due from day 2, Wednesday 13 November. There is then a daily Slight Chance of G1 as a result, with the very start and very end of the four days perhaps most reliably Quiet.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is at Background levels. There is a rising slight chance of S1/Minor solar radiation storms, mainly due to any significant flares from AR3889 as it rotates into a potentially more geoeffective position in the western hemisphere.

The high energy electron flux may rise to diurnal high peaks in the period, with the associated fluence nevertheless most likely persisting below Active levels.

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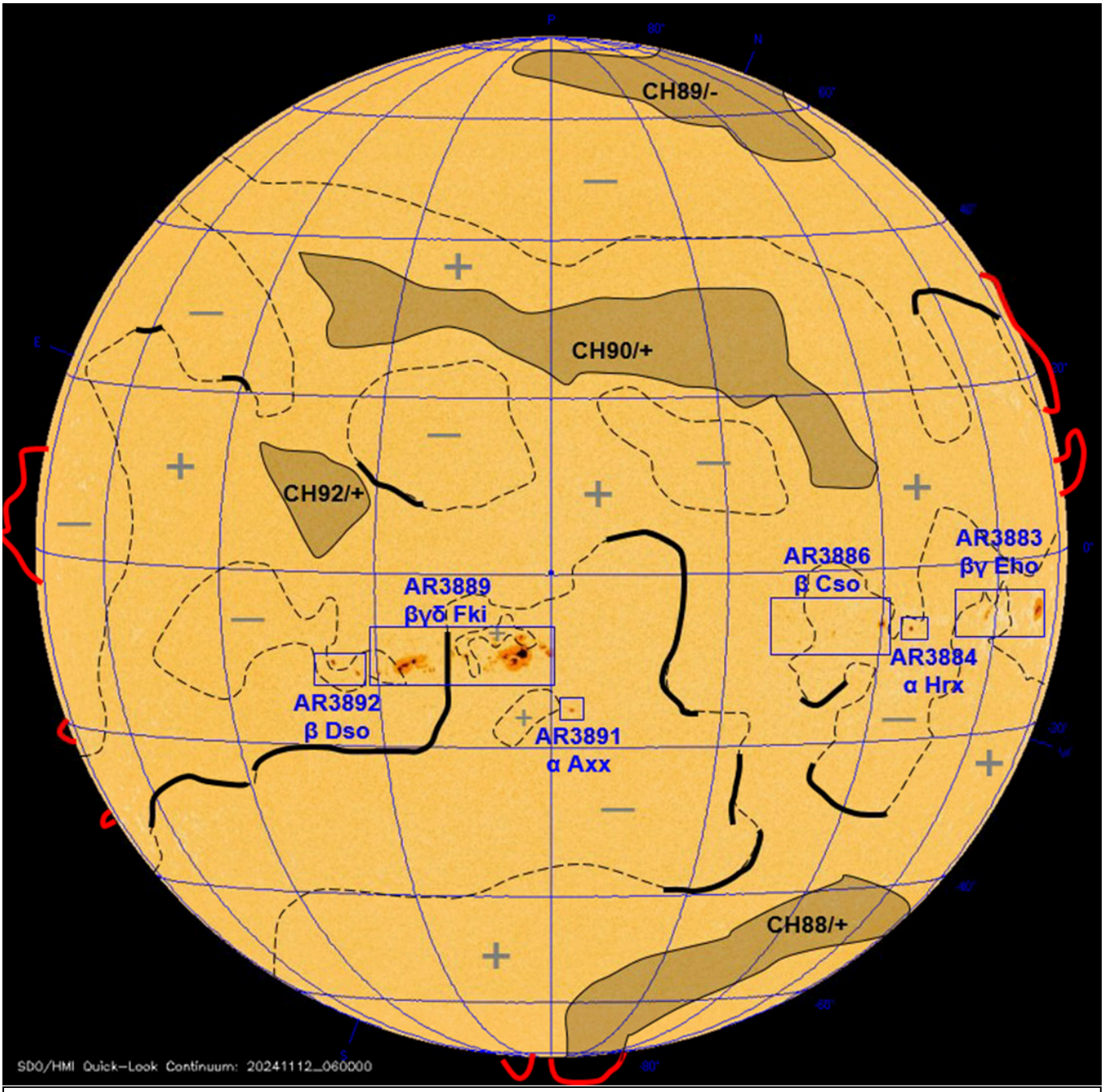
Figure 1: Solar synoptic map, valid 12/0600UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs feature in the forecast, although there are numerous filaments on the disc and AR3889 is currently crossing the solar meridian, both of which warrant monitoring.

The four-day forecast therefore comprises fast wind influence only. The recent fast widn from CH88 has now ceased and that from CH90/+ is awaited as it moves into the western solar hemisphere. This feature was present on previous rotation, although smaller and with the promontory towards the solar equator absent. Solar winds reached up to 450-500km/s on previous rotation, which is also expected based on persistence from Day 2 (13 Nov). MOSWOC Enlil is providing reasonable guidance for the start of the period, however it does not suggest connection to CH90/+. This is considered an unsafe assertion given the coronal hole's position on the disc, and as such confidence in Enlil is low through the period.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp1-3) on Day 1 (12 Nov). Unsettled to Active (Kp3-4) conditions are expected from Day 2 (13 Nov) due to a HSS from CH90/+, with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5) during the remainder of the period - mainly owing to the feature's large longitudinal extent.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X-Ray Flares

Solar activity fell to Low in the period, with occasional mid-ranking C-class flares observed, mainly from AR3889. There are six sunspot regions on the visible disc. AR3889, in the southeast, is the largest and most complex region. It contains a number of mature spots with at least two delta regions. Also potentially of note is AR3883 in the southwest, has mature leading and trailing spots, and has seen some recent decay of its smaller spots within its intermediate portion. The remaining spot regions are apparently stable and magnetically simple.

The Carrington location for Ex-AR3863 is due over the eastern limb inside 24 hours' time, however no significant regions depart the front-side, and the daily risk of significant flares is therefore held flat throughout.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	70	70	70	70
Very Active	**R3-R5 (X Class)**	No	20	20	20	20

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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is at Background levels. There is a rising Slight Chance of S1/Minor solar radiation storms in the period, mainly due to any significant flares from AR3889 as it rotates into a more geoeffective position in the western hemisphere. This rising trend has been slightly softened relative to recent guidance as there are now relatively fewer flares and potential sources compared to recent days.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is at Normal Background to Moderate levels.

Persistence-wise, Earth is now approaching a period where spells of High flux are most likely in the 27 days, with diurnal highs narrowly reached on last pass of CH90's predecessor. 24-hour fluence levels should still fall short however, and MOSWOC REFM is considered to be offering reasonable guidance in this respect - although it may well be a closer approach to 1e8 integrated pfu than shown.

Al considered, there is a rising slight chance of Active fluence, peaking later in the coming UTC working week after geomagnetic activity subsides from the onset of CH90.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

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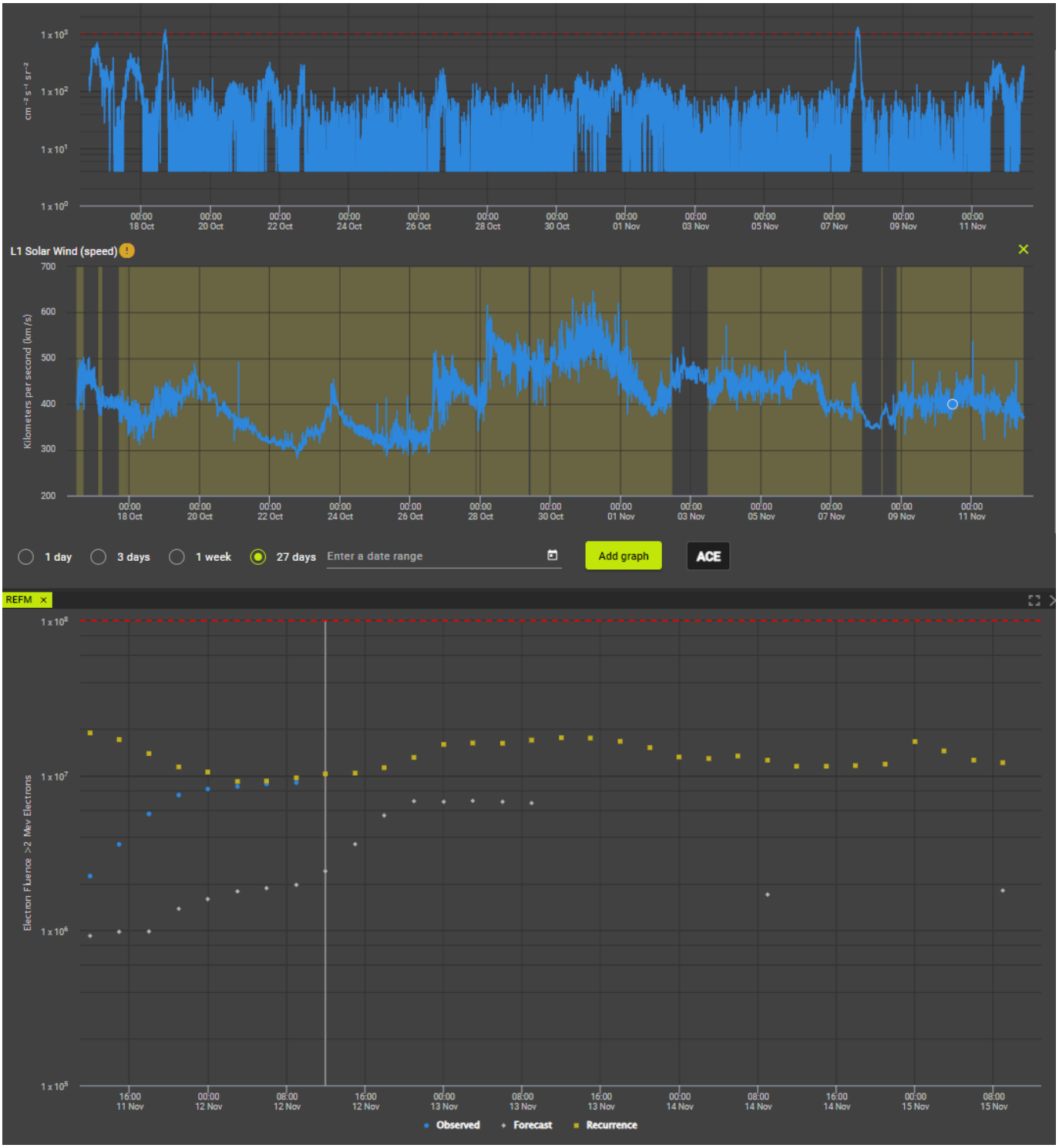
Figure 2: 27-day GOES16 electron flux levels at GEO, driving solar wind speed at L1 and coming 72-hour MOSWOC REFM forecast. Note that the analogue of CH90/+ delivered amongst the highest electron flux of the past rotation, with similar expected on this pass.



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